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ABSTRACT

This volume contains the major presentations of two conferences on the theme: "Low Achievers in Mathematics and Title 1, ESEA" attended by mathematics educators in New York State. Melvin Mendelsohn summarizes "Activities of the Bureau of Mathematics Education Related to Title I, ESEA". "Cognition and Learning Style of the Disadvantaged" is discussed by Nicholas Troisi. Lucille Stovall highlights "Instructional Techniques for Low Achievers in Mathematics". Natalie Mintz's topic is "Training Teachers to Work With Educationally Disadvantaged Students". "Organizational Change for Teaching the Disadvantaged" is discussed by Charles Pflaum. Winsor Lott outlines "The Use of Tests in Programs of Mathematics for the Educationally Disadvantaged". Beryl Hunte highlights "Research Studies" relevant to mathematics education of the educationally disadvantaged. (JM)

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MATHEMATICS EDUCATION

AND THE

EDUCATIONALLY DISADVANTAGED

UD 009472

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Albany, New York 12224

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FOREWORD

Results of the mandated Arithmetic Tests for New York State Elementary Schools at grades 3 and 6 indicate a need for a re-evaluation of mathematics instructional programs and services offered in our schools for educationally disadvantaged students. The significant percentages of grade enrollments below minimum competence levels across the State direct us to plan and implement Title I, ESEA programs in mathematics education. These programs will allow us to begin to cope with the serious problem of low achievement in mathematics, for large numbers of our educationally disadvantaged students.

Mathematics educators in New York State have attended two conferences, with the theme: Low Achievers in Mathematics and Title I, ESEA. The conferences were cosponsored by the Bureau of Mathematics Education, under the direction of Frank Hawthorne, Chief, and the Office of Title I, ESEA, Dr. Irving Ratchick, Coordinator.

The purpose of both conferences, March 17 and December 1, 1967, was to meet and discuss problems related to mathematics education of disadvantaged students in order to motivate school districts to provide mathematics programs under Title I, ESEA, concerned with the education of educationally disadvantaged children from economically deprived families.

The emphasis in the programs was on the providing of practical information and suggestions from various points of view and levels of authority. Speakers included college professors of mathematics education and continuing education, city directors of mathematics, mathematics educators with the responsibility of instruction and/or research, and State Education Department personnel.

This publication contains, basically, the major presentations of both conferences. Melvin Mendelsohn, Associate in Mathematics Education, who planned and coordinated both conferences, edited and prepared the presentations for publication.

Walter Crewson

WALTER CREWSON
Associate Commissioner for
Elementary, Secondary, and
Continuing Education

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ACTIVITIES OF THE BUREAU OF MATHEMATICS EDUCATION RELATED TO TITLE I, ESEA

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Introduction

The Elementary and Secondary Education Act of 1965 was enacted in April 1965, as P.L. 89-10. Its declaration of policy is: "... to provide financial assistance to local educational agencies serving areas with concentrations of children from low income families to expand and improve their educational programs by various means which contribute particularly to meeting the special educational needs of educationally deprived children." Appropriations were allocated in September 1965.

On September 30, 1965, a position of Associate in Mathematics Education was added to the staff of the Bureau of Mathematics Education. One of the primary functions of this position is to provide consultation and assistance to school systems in New York State in the formulation and operation of program proposals in mathematics education under Title I, ESEA, make recommendations for approval or disapproval of submitted projects, and conduct evaluation of operational programs.

The following table shows the number of approved Title I, ESEA mathematics education projects, and the amount of funds expended on such projects, in fiscal years 1966, 1967, and 1968.

Appr[illegible]ed Title I, ESEA Mathematics Education Projects
And Funds Expended on Such Projects
Federal Fiscal Years 1966, 1967, and 1968

	FY 1966	FY 1967	FY 1968
Number of Projects	124	110	133
Funds Expended	$1,800,000	$3,300,000	$4,100,000

Besides the primary functions stated above, another important function is that of dissemination. Such questions as: "What happens?", "How does it happen?", "Where is it happening?", are answered through dissemination of information. Conferences, presentations, and published materials are the vehicles utilized for this purpose.

Conferences

In the past 3 years, 16 conferences have been held at which mathematics education was part of the program, and 4 conferences have been held with mathematics education encompassing the entire program. Seven conferences were held in October and November of 1965 concerned primarily with the question: "How do you start planning Title I projects?" They were held in Albany, Buffalo, Plattsburgh, Poughkeepsie, Rochester, Suffolk County, and Syracuse. Nine conferences were held in November 1966 concerned with the follow up to the National Conference on the Education of the Disadvantaged (Washington, D.C., July 18-20, 1966). The major topics which were treated at each of the conferences were: 1. Diagnosis of the problem; 2. Strategies for action; 3. Effective approaches; 4. Mobilization of resources. The conferences were held in Albany, Buffalo, Nassau County, Newburgh, New York City, Plattsburgh, Rochester, Suffolk County, and Syracuse.

On March 17, 1967, the Bureau of Mathematics Education sponsored a conference, in Albany, with the theme: Low Achievers in Mathematics and Title I, ESEA. The conference had four main objectives: 1. to identify the mathematics curricula being developed and implemented for mathematically disadvantaged students; 2. to consider approaches to the problem of inservice and preservice education for mathematics teachers of low achievers; 3. to identify types of research studies being carried on in the field of low achievement in mathematics; 4. to describe ongoing Title I, ESEA projects in mathematics. Field invitations were extended to the directors and chairmen of mathematics from cities and school districts receiving high allocations under Title I, ESEA.

Two follow up conferences with the same objectives as the March 17 conference were held in May 1967, in Huntington (Suffolk County) and Rochester. The titles of the conferences were, respectively: How Can We Improve Mathematics Education Through Title I? and Seminar on the Underachiever in Mathematics.

On December 1, 1967, the Bureau of Mathematics Education sponsored a second conference in Albany, with a similar theme: Low Achievers in Mathematics and Title I, ESEA. It had three main objectives: 1. to describe the cognitive development and learning style of mathematically disadvantaged children; 2. to discuss the utilization of standardized tests in evaluation of mathematically disadvantaged students; 3. to identify meaningful and concrete instructional techniques geared to low achievers in mathematics. Invitations were extended to leading mathematics educators from city school districts of New York State.

Presentations

Two major presentations have been delivered concerning mathematics education and Title I, ESEA. Developing Mathematics Programs for the Educationally Disadvantaged was a presentation delivered in Syracuse, Massena, and Rochester in October 1965, April 1966, and May 1967, respectively. Following is a summary of the talk.

The development of a comprehensive mathematics project under Title I, ESEA is constructed with the thought of the project becoming functionally integrated into the overall school program.

Four general areas constitute a project format: pupil evaluation, curriculum development, teacher training, and classroom organizational structure. Each of these areas is interrelated, and overall project evaluation developed along with the format.

Pupil evaluation consists of three phases: identification, diagnosis, and achievement.

Curriculum development is the next area to be considered. A broad statement of desired outcomes is decided upon before any other work in this area is contemplated. The three general outcomes that mathematics instruction strives for, are: computational skills, mathematical understanding, and problem solving. After the outcomes are decided upon, curriculum materials are developed.

Current thinking on curriculum emphasis for educationally disadvantaged students leans strongly toward academic content.

Teacher training is best carried out in conjunction with curriculum development. Five topics need to be concentrated upon in this area:

1. Mathematics programs and modern instructional techniques
2. Characteristics of the educationally disadvantaged
3. Emphasis on instructional techniques for the low achiever
4. Curriculum and textbook examination and study
5. Purposes and procedures of evaluation

The last area is that of classroom organizational structure. This is where the other three areas of evaluation, curriculum development, and teacher training, are put in operation. A full school year program is emphasized because of the eventual assimilation into the total school program. A possible summer session could be included for reinforcement fundamentals and/or enrichment.

A child's full learning ability will be realized when a proper home environment is supported by good environmental conditions in the school. These conditions are fostered by various classroom organizational patterns. To identify a few: interclass or intraclass ability grouping, ungraded classes, and small group instruction.

The particular structure decided upon, and the mathematics project developed under Title I, ESEA, should be an outgrowth of the local system's educational philosophy so as to fit into the overall school program.

Federal Funds for Mathematics Education was a presentation delivered in Oneonta, Greenlawn (Suffolk County), Warsaw (Wyoming County), Syracuse, Las Vegas Nevada, and again in Syracuse in February 1966, March 1966, April 1966, May 1966, April 1967, and May 1968, respectively. Following is a summary of the talk.

Three points are clear concerning federal funds for education. They are to be used for: 1. attacking special problems (represent categorical, not general aid); 2. developing new programs;

3. supplement state and local revenues.

The Federal Government's effort appears to be more dramatic, only because it is more recent. Federal funds are approximately 9 percent of expenditures for public education in New York State.

The role of the three agencies should be thought of as Federal concern, State responsibility, and local control.

Exemplary projects under the following federal grant programs are then described: 1. NDEA, Title III - financial assistance for strengthening instruction in science, mathematics, modern foreign languages, and other critical subjects; 2. ESEA, Title I - policy stated in Introduction; 3. ESEA, Title III - a program for making grants for supplementary educational centers and services, and to stimulate and assist in the development and establishment of exemplary elementary and secondary educational programs to serve as models for regular school programs; 4. ESEA, Title IV - to make grants for research, surveys, and demonstrations in the field of education, and for the dissemination of information derived from educational research.

Published Materials

Guidelines for Developing A Title I, ESEA Mathematics Project was first published in the New York State Mathematics Teachers Journal, April 1966. The guidelines followed closely the presentation titled, Developing Mathematics Programs for the Educationally Disadvantaged, described previously.

The next publication involving mathematics education and the disadvantaged was: Experimental Materials for a Course in Seventh Grade Mathematics - Adapted for Disadvantaged Students, published by

the Bureau of Secondary Curriculum Development, State Education Department, March 1967. Following is a description of the materials.

The concepts of mathematics and a proficiency in the use of the tools of this subject are as important for disadvantaged students as they are for others. This course is an adaptation of Mathematics Courses for the Seventh Year and the Eighth Year, geared specifically to the needs of the disadvantaged student. An attempt has been made to offer a solid body of content with intellectual challenge. The difference is in the approach. Since the experimental background of disadvantaged students is usually limited, the teacher is urged to capitalize upon the familiar and known experiences of these youngsters. It is assumed that in many cases the meanings and skills taught in earlier years will need reinforcement or re-teaching to be brought to an operative level.

Heavy emphasis is placed upon using the familiar objects in the environment of the students. They are urged to develop their own math portfolio. When feasible, the experiences of pupils are used to help develop concepts.

Selection of unit topics is based on the assumption that the basic needs of the disadvantaged student are the same as those of the advantaged pupil, not something different or less. However, the motivating devices and the teaching techniques differ. Traditional exercises are suggested for review and reinforcement purposes only.

The next two publications were reports of each of the Low Achievers in Mathematics and Title I, ESEA conferences, described previously.

25 Mathematics Education Programs is another publication distributed by the Department. It was published by the Office of the Coordinator - Title I, ESEA, January 1968. This compendium provides program descriptions for 25 Title I, ESEA projects involved with mathematics education. The projects selected give a range of coverage in different instructional and service domains, including curriculum development, inservice training, and small group instruction. Also included is a suggested format for the development of Title I, ESEA mathematics projects.

Conclusion

This review of activities brings up to date the "happenings" involving the Bureau of Mathematics Education and Title I, ESEA. The future of Title I, ESEA holds great promise for alleviating the mathematics disadvantagement of economically deprived children. As mathematics educators it is our mandate to offer comprehensive programs, K-12, for children at all levels of ability, and from various environmental strata. With Title I, ESEA as a tool, we can now provide expanded and improved mathematics programs for the economically and educationally disadvantaged child. Our responsibility is to formulate ideas, and to develop, promote, and implement programs concerned with the mathematics education of such deprived children.

COGNITION AND LEARNING STYLE OF THE DISADVANTAGED

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This presentation is organized into the following three parts:

1. A review of the general characteristics of disadvantaged children..
2. A discussion of the cognitive development and learning style of mathematical disadvantaged students.
3. Implications, in a broad, general nature, for helping disadvantaged children learn mathematics.

The characteristics of the disadvantaged have been amply described in a number of publications. These reports stress the lack of verbal stimulation in the home. These children do not have an adequate language with which to clarify ideas when communicating with others at school. Examinations of diary, and materials of lower class children in city slums can show a rapid shift from one activity to another, characterized by a lack of attention to one thing. One is impressed with the meagerness of experiences with abstraction. For example, at dinnertime, which is the only time that parents and children are together, tends to be spent on two things: to mete out the punishments for infractions committed the day before, and to allocate the chores that have to be done. In one group of 25 eighth graders, only one family was found who used dinnertime to describe what happened to them during the day. Moreover, these conversations were limited to the immediate present and generally did not include time sequences, relationships between concepts, logical sequences, or casual relationships. Consequently, these children have little

understanding of things, places, and events, and people which are commonly familiar to children entering school.

These young people lack the motivation to learn. They come from homes that have few or no reading materials, and little respect for people who do have.

The syndrome of feelings and attitudes which the majority of culturally deprived children tend to share are as follows:

Both the family climate and the experience tend to induce a feeling of an alienation, their self concept is low. They question their own worth; have a fear of being challenged; have a desire to cling to the familiar and have many feelings of guilt and shame. There is a limited trust in adults. They tend to respond with trigger-like reactions, are hyperactive and have generally a low standard of conduct and they usually show apathy and lack of response. It is difficult for them to form meaningful relationships. These tendencies translate themselves into an attitudinal orientation which is difficult for teachers to understand. A negative attitude exists toward school, teachers, and achievement. The tendency to seek immediate gratification over and above any long range purposes, the freer use of violence in solving conflicts than is permissible in the school setting also prevails. Some of this conduct, such as fighting, plays havoc in schools, therefore, causes disciplinary action and misinterpretation.

Discrepancies exist also between the motivational techniques used in their motivational patterns. Achievement as a means of making further education possible is relatively understood. Getting by, rather than getting ahead is therefore the rule. Hence, grades,

promotions, and all other similar external incentives used by the schools do not work nearly as well as expected. Children of disadvantaged groups do not share the intensity of desire for a high grade. The sort of homes from which too many of them come have not fostered the strong desire to learn that is present in so many of the more advantaged children. Thus, lack of desire is one of the factors which must be considered when teaching disadvantaged children. Numerous past failures of the disadvantaged children also contribute toward their indifference to school work in general, and mathematics in particular.

Researchers and experienced teachers agree that these children can learn if adaptations are made in the curriculum and ways of teaching devised to reach them. Because of the disorganization of their environment, the basic perceptual frames of these children are not properly constituted. Houses and people are in a constant state of disorder; things do not run on time.

To master mathematics, the central idea of which is order, these children need to be formally introduced to fundamental shapes and categories.

Studies of intelligence show that it is a product of a transaction between an individual and the environmental stimulation. Intellectual stimulation is described as a product of an interrelationship of three factors: individual potential is presumably evenly distributed among all groups of people and probably greater than that which we have as yet learned how to release. Environmental stimulation involves more than the degree, complexity, and variation of the environment. It also involves motivation, or the extent to

which the environment affects the individual's responses. The variations of these responses are generated in part by the individual's motivation and in part by the availability of adult mediation in facilitating conceptualization. A potentially rich environment may, therefore, be functionally unstimulating if it is exploited to the fullest. Martin Deutsch, speaking on the disadvantaged child and learning process at a conference held at Columbia University on curriculum and teaching in depressed urban areas, pointed out that the greater the variety of stimulation and number of situations which challenge modifications of conceptualization, the more mobile and differentiated the mental structure becomes. In other words, the more the child hears, sees, and interprets or is being helped to interpret, the more likely he'll want to see and hear, and the more he will get from what he sees and hears. The greater the variety of reality situations with which the child copes, the greater is his ability. Deustch further points out that slum life provides a minimum range of stimulation and of opportunities to manipulate objects or to experiment with them in an orderly manner. Restriction in the range of the variety of input limits the output in expression and reduces the prevision and the ability to perceive relationships or other abstract qualities such as size, shape, distance, and time.

Although the deprivations are generally recognized by teachers and school people, little has been done to accommodate school experience to needs of the disadvantaged.

The result that is beginning to emerge is that the meaning of deprivation is a deprivation of meaning. This is a cognitive environment in which behavior is controlled by status rules rather than by

the attention to individual characteristics of the specific situation, and one in which behavior is not mediated by verbal cues or by teaching which relates events to one another and the present to the future. This environment produces a child who relates to authority rather to rational reasoning. He often complies but is not reflective of his behavior. The consequences of an act are largely considered in the terms of immediate punishment or reward, rather than future effects and long range goals.

An effective and appropriate teaching strategy for the culturally deprived child must, therefore, emphasize these three considerations: 1. a selection of initial learning material geared to the learner's existing state of readiness; 2. mastery and consolidation of all ongoing learning tasks before new tasks are introduced, so as to provide the necessary foundation of successful sequential learning, and to prevent unreadiness for future learning tasks; 3. the use of structured learned materials, optimally organized to facilitate efficient sequential learning.

If all students are to learn effectively the content, attitude and skills deemed important by the school and society, the following two factors are essential:

1. Learners, first, must view the goals of education as basically worthy.
2. Learners must be willing to engage in the behavior necessary to achieve such goals.

In other words, the students must motivate themselves. A great gulf often exists between those goals perceived as worthwhile by the student and those established by the schools. The greater this discrepancy, the less readily will these latter goals be accepted and

the less motivated will the students be. Even if the disadvantaged learner becomes willing to accept the goals of the school as worthy of pursuance, then numerous factors associated with his social position can weaken his level of motivation and chances of success. Among such factors are a lack of prior social and environmental experience which is a prerequisite for school learning, parents who lack knowledge of the educational process and ways of helping the child, a dearth of skills basic to effective learning, and the acquisition of a cognitive style that in many ways is incompatible with the ways and styles of learning required by the schools.

The effects of this restricted environment includes poor perceptual discrimination skills, the inability to use adults as sources of information, reality testing instruments for satisfying curiosity, impoverished language symbolic systems, and a paucity of information, concepts, and relational propositions.

Research on the cognitive style and language patterns of the disadvantaged suggests the need to capitalize on the materials and tasks in using operational and concrete rather than verbal stimuli. To cultivate mental activity without the hindrance of poor language development, indicates the value of using audiovisual and kinesthetic materials, developed with the purpose of providing for concrete thought operations through manipulation and experimentation with objects and processes. In effect, this would amount to providing a greater variety of modes of learning. In addition to learning from books, provisions are needed for examining objects, processes, and emphasizing analysis, comparison and precision in verbal description to cultivate the mental structures with which to turn later to books.

The research on motivational pattern suggests futility of emphasis on external regards and the need for stressing the kindling of curiosity, the opportunities for experiencing one's power over the materials, and other intrinsic motivating devices.

The disadvantaged appear to think in special terms rather than temporal terms, even though their limited temporal perspective produces difficulties such as a poor time perspective of past, present and future. Spacial focus has a positive side to it. In developing concepts of space, teachers can guide children to make maps, identify landmarks, develop contrasting concepts of space, such as small and tall, big and little, indoors and outdoors, to distinguish a particular kind of place to work puzzles, etc.

The curriculum for the disadvantaged needs to be current, imaginative and compact. The methodology in contrast to rote learning, rules and facts, encourages the student through experience to develop his own conclusions and generalizations instead of passively listening to what the teacher tells him. He becomes a partner in the learning of what they believe and what they see. They feel and count and group. They experience real things and learn other things from the teacher or textbook. They work with authentic materials. The abstractions are now understood because they are internalized. The new curricula avoid dead ends. Activities are planned so that one leads to others. Each solution raises more questions that require further probing. Knowledge should direct the knower into other spheres of knowledge, as in rocket blast off, first step one sets off step two which in turn sets off the following steps. Each group of learnings should open doors to other groups rather than be a self-contained chamber.

Because of environmental limitations, children from disadvantaged homes particularly need the stimulus of this kind of probing into the world and field of thought.

Mathematical abstraction must be presented in as concrete a representation as possible. You never know in advance which device might be the one item to help a particular student. It is a kind of a buckshot approach where the greater the variety of materials available the higher the probability of reaching each child.

In summary, it can be said that the following characteristics are thoroughly typical of the disadvantaged child's learning style:

1. Physical and visual rather than aural.
2. Content-centered rather than form-centered.
3. Externally oriented rather than introspective.
4. Problem-centered rather than abstract-centered.
5. Inductive rather than deductive.
6. Spacial rather than temporal.
7. Slow, careful, patient, persevering (in areas of importance) rather than quick, clever, facile, flexible.

As has been true since the days of Quintilian, Comenius, and other great educators, the utilization of sound teaching principles, provides for individual needs, interest and ability. Effective teaching will change despair to hope, failure to success. Herein lies the hope of the disadvantaged.

INSTRUCTIONAL TECHNIQUES FOR LOW ACHIEVERS IN MATHEMATICS

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Attempts to improve the mathematical competency of low achievers are a practical expression of our belief in the worth of every human being in our democratic society.

Post Sputnik programs in mathematics have, for the most part, been geared to the abilities, interest, and needs of the more able, the talented, the college bound student.

Belatedly we come to accept the premise that in this age of technology we cannot afford to neglect the needs of any single individual no matter how high or how low his academic potential may be. Therefore, we address ourselves to the problem of isolating specific techniques that will provide for the lower achiever a mathematical environment that will insure successful learning experiences.

Our frame of reference for considering the problems of low achievers in mathematics is the year old Title I program of Corrective Mathematics in the nonpublic schools of New York City. Early in this program we faced the problem of deciding what mathematics the low achiever needed to learn, or how the mathematics curriculum should be adjusted to his needs. We followed generally recommended procedures for identifying the specific learning difficulties to be corrected. We administered standardized tests and studied school records.

We diagnosed errors made on the tests to determine topics needing development. We discussed children's problems with classroom

teachers and school administrators. We examined textbooks and classroom materials to determine pedagogical approaches and curriculum content. These efforts resulted in certain findings.

First: Fourth, fifth, and sixth grade children attending nonpublic schools had failed to develop the concept of place value.
Second: This failure had an adverse effect on computational skill.
Third: Emphasis on rote learning failed to develop ability to see number relationships and to think logically.
Fourth: Much drill and practice on basic facts had failed to increase ability in computational skill and problem solving.
Fifth: The attitude of the children was one of defeat.

These findings indicated a need for organizing a basic mathematics curriculum for the low achievers. This curriculum must include the study of number relationships, the structure of our decimal numeration system, varied approaches to developing algorithms and many, many experiences in problem solving situations.

Also indicated was a need for giving low achievers sufficient time for developing ideas and for absorbing learnings. Most classrooms are organized for accomplishing an abundance of learning activities in a short time span. Low achievers, underachievers, and slow learners cannot keep pace with average and above average learners. They need more time for the formulation of ideas. They need more time for developing skills and concepts. For them the curriculum must be presented in small doses for longer periods of time.

To offset the attitude of defeat produced by school failure we recognized the need for finding those techniques that would encourage pride in achievement while facilitating learning growth. We placed children in small groups so that instruction could be individualized.

We trained teachers to use a diagnostic approach for remedying learning difficulties. This approach replaced peer competition with pride in individual self-development. We encouraged each child to maintain a personal folder, which became a log of his activity in the mathematics group. The personal folder included such items as practice work, pictures and diagrams illustrating mathematical principles, step-by-step procedures for developing a process, and practice tests. Each child was encouraged to keep an individual record of his progress.

This record became a part of the personal folder. We encouraged children to bring in materials, to create problems. Some children made individual study cards for learning basic facts, number relationships, and fractional equivalents. Attractive displays of the work done by pupils was effective in creating a desire to succeed in further mathematical tasks.

Lower achievers tend to become disinterested in school subjects, especially mathematics. They frequently display an "I don't care" attitude.

We found it necessary to use varied techniques for motivating interest and for creating sustained attention. A plethora of demonstration and manipulative materials was provided. Demonstration materials must be attractive and colorful to gain attention. They must be simple in arrangement and content to provide meaningful learnings.

We used commercially prepared 1-100 number charts. These were effective in showing sequence of number, in developing skill in group counting, and in decade work in addition and subtraction.

We used commercial and teacher-made number lines to provide a modern approach for developing basic facts and computational skills. Colorful felt circles cut in halves, fourths, sixths, and eighths were used to develop concepts of fractions and fractional parts. Tens' frames, squared materials, thermometers, flannel boards, discs, and rulers were provided. Children were encouraged to bring in such things as bottle caps, acorns, straws, trading cards. These small easy to handle objects were for counting, for grouping, for testing, and for proving the commutative and associative laws. Of course, the teacher had to exert careful control and guidance. The pupils had to have a genuine interest and desire to improve learning skills. Otherwise these very attractive, small, easy to handle manipulative materials could become satellites, missiles and other flying objects.

We found the use of colorful transparencies in the overhead projector valuable in stimulating interest for those topics that had to be redeveloped. We needed this variety of audiovisual materials, demonstration materials, and manipulative materials to overcome the short attention span of low achievers.

The perception of number patterns and abstract reasoning are difficult for low achievers. Rote learning, where children are <u>trained</u> to imitate the teacher's performance of an arithmetical computation, fails to develop mathematical insights needed for real understanding. For the low achiever we needed to use the materials just described to concretize mathematical learnings. We needed to provide time, much time for children to experiment with beads, discs, pebbles, bottle caps. Then we needed to allow time for guiding pupils in the use of the materials as learning aids.

Younger children were helped to see and to understand the relationship between addition and subtraction as they combined and separated "thing" in groups. Older children could actually "see" the operations of addition, subtraction, and multiplication with like, related and unrelated fractions as they combined, separated and changed halves, fourths, eighths, sixths, thirds, etc. Squared materials were used by children, first to develop concepts of place value, and later to "diagram" expanded notation. Using the hundred square, the ten strip, and the unit helped children to understand the meaning of 237 as 2 one-hundreds, 3 tens, and 7 units.

We encountered one major difficulty in the use of concrete materials. Our teachers were anxious to get to paper and pencil arithmetic. The training program for teachers sought first to help them realize the need for many concrete learning experiences. Secondly the program sought to give teachers a sequence to lead from the concrete experience to abstract reasoning. Teachers needed techniques for moving from the pebbles and discs to the number line, and finally to the arithmetical formula. Finally they needed to learn new techniques for developing computational skills and for relating these skills to realistic problem solving situations.

To help low achievers grow in ability to compute, we used techniques suggested by modern programs such as SMSG, SRA, Madison Project, as well as the New York City curriculum bulletins in mathematics. We encouraged the use of number sentences, open sentences, equations, frames, and arrays. We encouraged the use of estimation and mental computation. We permitted testing of their answers. We provided a variety of practice exercises in colorful workbooks, in

Magic Slates. We trained teachers in the efficient use and construction of class ditto sheets so that practice work would be an outgrowth of group learning activities.

We allowed different approaches to the solutions of the same problem. For example: 37 + 25 could be thought through as 37 + 20 and 57 + 5 = 62 or children might think 30 + 20 = 50; 7 + 5 = 12; 50 + 12 = 62. Still others might use the algorithms suggested in the SMSG text for grade 4.

37 + 25 12 + 50	The units are added and the 12 written below the line. Then the tens are added and 50 is written below the 12. Finally the 12 and 50 are added to arrive at a final solution.

We showed pupils how the laws of our numeration system serve to make computation easier. We had pupils apply the law of distribution to problems such as 5 x 43. We found that students could learn to understand and apply these laws.

We recommended the application of mathematical knowledges and skills to real life situations so that pupils could understand the need for learning to compute. Children were encouraged, for example, to compare weekly sales prices in neighborhood stores. Problems based on advertised prices were presented.

"If 14 oz. canned corn is priced at 2 cans for 37¢ in store A and 17¢ per can in store B, in which store would 3 cans of corn be less expensive?" Numerous problems in the four operations were generated from sales advertisements and shopping lists.

Opportunities and experiences for measuring time, distance, space and weight were provided.

We wanted children to realize the tremendous force of mathematics in our everyday lives. Hence we concentrated on problem solving situations that had direct bearing on everyday experiences Children were encouraged to chart their growth in problem solving ability. They were helped to understand the need for continued practice so that newly learned skills would not be forgotten.

Lower achievers generally have poor retentive power. Therefce, we needed to provide for them daily and diversified drill and pracice in order to insure successful mastery of new skills. To make necssary drill periods exciting as well as worthwhile we used games, puzzls, magic squares.

We alerted teachers to the oft-repeated principles for drill procedures. We trained teachers to base drill on the individual needs of pupils, to keep drill periods short and lively, to use vried kinds of drill - written, oral, individual, team competition. We encouraged children to make and use individual study cards. We showed teachers how to use the laws of commutation, association, nd distribution to vary drill. We planned drill exercises that woul develop ability to discover number relationships and number pattens. Children responded favorably to the input-output game which teste their ability to tell what operation the computer performed on inut material. Problems cut from discarded books and workbooks were pasted on 5 x 8 cards and filed in a box. These provided additioal independent practice for pupils.

Low achievers have individual needs in terms of time requird to master subject matter and time required to complete written assignments. Because the bell curve operates even in carefully

selected small groups of underachievers, there was need for differentiated assignments and individualized instruction. We met this need setting up an activity table to which children could go for additional practice work, progress tests, games, puzzles or special study cards. Teachers were trained to help children plan their individual activities in order to prevent interruption of teaching and to discourage idleness. Good techniques, excellent materials, modern equipment should result in improved learning. However, we must consider the teacher, the most important instrument in the learning process.

The teacher must be patient and flexible, she must be secure in the knowledge that the low achiever can and must be helped to learn. She must be able to recognize and willing to understand the low achiever's need for directed self-improvement. The teachers must be skilled in using the techniques described for guiding the low achiever up the ladder of mathematical competency.

The techniques are important, but the teacher is all.

TRAINING TEACHERS TO WORK WITH EDUCATIONALLY DISADVANTAGED STUDENTS

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BRIDGE Project, (Building Resources of Instruction for Disadvantaged Groups in Education), was to find ways of effectively preparing all teachers to work in culturally deprived neighborhoods. The problem was twofold:

1. How to bridge the gap between essentially middle class oriented teachers and the lower class youth of varied ethnic backgrounds present in public junior high schools and,
2. How to modify the college curricula so as to meet the future teacher's needs and prepare the teachers for the unique problems of classroom instruction at the grass roots level in the low achievement schools.

The preparation of teachers is, of course, only one aspect of this problem. It has been true in the past that teachers generally prefer to teach in those schools where the best conditions of work are present and the responses of the pupils most stimulating. The consequence of this desire has been to relegate much of the education of the children in slum-area schools to inexperienced teachers, many of whom either leave teaching or escape to more desirable locations. The staff of the Education Department at Queens College was aware that their students tended to follow the general pattern, prefering either to teach in suburban communities or in those areas of the city where middle-class whites lived. They were also aware that many of the young graduates of the College who accepted teaching assignments in low socio-economic area schools reported encountering severe problems of bridging the gap between middle-class, academically

oriented whites preparing to be teachers, and the lower-class white, Negro, and Puerto Rican youth who form a large part of the pupil population in the slum schools of New York City.

The general goal of the BRIDGE Project was to discover what modification of, or addition to, the present program of teacher education would more effectively prepare teachers for work in secondary schools in culturally disadvantaged areas. The tasks enumerated below were seen as approaches to the major objective:

1. To study the problems of beginning teachers in a depressed area junior high school as they worked with three classes of children for a period of three years.
2. To test the hypothesis that the creation of a small-school-within-a-school, in which three teachers and a coordinator would work for three years with three classes of children, would produce more growth in intelligence and achievement than the customary assignment of teachers and pupils in junior high schools.
3. To determine whether or not the reported decline in IQ scores among children in slum areas was a fact or simply an artifact of the instruments used to determine their scores.
4. To determine whether or not a culture-fair group intelligence test would more accurately predict growth in school achievement than the currently used group intelligence tests.
5. To determine whether or not the intellectual functioning of children in slum schools differs in any fundamental way from the intellectual functioning of populations on which tests have been standardized.

6. To determine whether or not there are any facets of intellectual ability among these youngsters which go unnoticed and untapped in the classroom they attend.

Three teachers, recent graduates of Queens College, were selected to teach English, Mathematics, Science, and Social Studies to the Project pupils for the three years of their junior high school education. One teacher taught both mathematics and science. Each teacher's full schedule was devoted to the instruction of the Project children. When the time devoted to teaching a subject (such as social studies) did not amount to the required duty-time for all teachers in the school, additional time was allotted to such instruction as reading, library, hygiene, or group guidance. Pupils and teachers were together for approximately two-thirds of each school day throughout the three years.

A supervisor or coordinator was selected to discharge the duties of training these teachers on the job, giving them assistance and emotional support in their difficulties, organizing the meetings of the Project staff (both school and college) which were held in the school, and in supervising the collection of teacher records and reports which were necessary for the research. She served in this capacity throughout the three years of the Project.

The teachers were involved in the everyday duties of all teachers, no matter the school or the community. The unique aspect of their work was the every day planning aimed at meeting the unique group needs of the children. (Reading level average -- 2.2 years behind, range 3.0 - 10.0. Seven out of eight pupils were below reading level at onset of project.) Throughout our work in this

laboratory classroom they sought appropriate approaches to the teaching of mathematics. Planning was not a one-day seminar, or a two-day workshop, but an everyday item on the agenda for three full years. With the help of a master teacher-supervisor, they planned specific activities (e.g. use of Gertz Xmas catalog). The official math texts were rarely used...semi-original and original teacher prepared materials were given to the students daily and combined by the students to form their own personal textbooks. (Texts were ordered as they discovered the needs of the three very different classes.)

Evaluation of what took place in the classroom was done almost immediately and remedies, where necessary, could go into effect often at once. The advantage being, that they were teaching in a fish bowl and didn't have to wait several weeks for feedback. They were able to see the units of work take shape, and to participate weekly in planning sessions with a college math consultant to evaluate what they tried.

The teachers on the project were able to share their common experiences, new materials, books and pertinent games and tricks. The staff as a group was able to focus attention on specific children (one per week in a case study conference) as to their reactions and learning difficulties in all the subject areas. They soon found that as their knowledge of the children increased, that certain units of work were required in math, namely basic math and consumer education. (Consumer education included installment buying, loan sharks, discounts, tax, packaging comparisons, etc.) They discovered that they

could not teach any advanced math concept without reviewing the basic algorisms, yet this was too dry for the children. They found that if they could create a desire or a need to learn a concept the basic computations needed for figuring out the answers became an easy thing to teach. However, isolated, unrelated math notions remained meaningless to students. They further discovered through trial and error, that because their students lacked the basic rudiments of math, the children were gullible to business sharpshooters. Teachers tried to help them visualize math in a realistic everyday context. They took trips to Macy's and watched the supermarket people train, attempting to use a cash register and adding machine in their own classroom. They visited banks, the stock exchange, and had visitors speak to the children about insurance and home buying. The needs of the children dictated.

In working on units in graphs, maps, and scales in general, the children had almost no concept of distance, e.g. distance from New York to Philadelphia ranged from 3 miles to 3000 miles...although many of the children moved their residences frequently, few had ever actually ventured out of their narrow neighborhoods, even to go as far as Times Square. So how could they know how far was Africa? Or where their brothers were fighting in Viet Nam?

Those youngsters who needed skill work in the algorisms wanted to work alone with their problems because they hated to admit their shortcomings. Frustration was common to the children who hadn't learned their multiplication tables. Students' work was individualized. (Each child had a separate skills folder of his own and was tested only after he was ready to be tested.) This encouraged

developing these vital skills as well as learning an elementary responsibility for responsible handling of school materials. (Folders and pencils were distributed and collected by students.) Toward the end of the second year the children were able to function on their own without direction from teachers.

Since the majority of the children were two or three years behind in reading at the onset of the project (grade 7), the teachers were obliged to teach reading, learning to do this on the job, as they needed these skills immediately. Generalities were soon translated into subject areas. Vocabulary in math was developed where possible with words children had seen and learned before (e.g. fraction and fracture; percent and cent; equal and equality). Understanding what were once insolvable problems, were built through the teachers' knowledge of context clues and comprehension skills.

While the teachers and pupils were learning, the college staff was active. There was always a professor working with a group of youngsters or observing a lesson in session. The professors liked the laboratory atmosphere, and were observing at first hand, what works and what doesn't. Regular conferences in each area included the appropriate college teacher. Through this type of conference and observation and participation the professors changed and exchanged ideas, and their curriculum and course content at Queens College changed.

As a dispenser of inservice education, the teaching staff was involved in training seven student teachers during the three years of the BRIDGE Project. These student teachers worked hard. They were involved in the planning and conference work; they taught the

children, and analyzed what they themselves did, and they were required to sit in on the general planning sessions. At these sessions they exchanged their own ideas about curriculum and its impact on the students. They had to explore many books in math content. By the time they had completed their required student teaching they were veterans at writing meaningful lesson plans and unit plans. They were not afraid to try different or new ideas and were not crushed by failure. Incidentally, all of the seven student teachers took employment in deprived neighborhoods.

Some of the pertinent conclusions drawn from the BRIDGE Project were:

1. The teachers' problems arose from their need to understand and adjust to aspects of lower class culture, from the absence of courses of study appropriate to the abilities, interests, and needs of the children, from their lack of such skills as an individualization of instruction, and from the physical and emotional strain involved in functioning under school procedures, regulations and conditions.
2. The pupils' uninhibited cursing, fighting, sexual interest, lack of respect for established authority and convention, and their failure to make a connection between school performance and adult success, confused and troubled the teachers. They needed guidance and help in developing an appropriate code in individual and group conduct by which to regulate their expectations.
3. The teachers had to build a new curriculum for the children. As beginning teachers this added to their already heavy burdens.
4. They had to learn to slow down the pace of their teaching and to discover and practice techniques of meaningful repetition.

5. The teachers had to learn to adjust to the variety of ability levels of the pupils. In doing this they had to discover or develop appropriate materials, invent techniques of individualization, and teach communication skills, especially reading, in all subjects.

The teachers learned from the BRIDGE experience that new teachers should not be sent into difficult areas as their first assignment. New teachers need a "period of adjustment": time to learn the ropes of the classroom, stage presence, administrative paper shuffling, and other routines. The new teacher needed to feel what happy teaching was like, working with a receptive audience. There is a tremendous emotional and physical strain attached to the job with the disadvantaged child. Nevertheless, after a long deep breath and perhaps a sigh, there is the reality factor. Teachers are needed in difficult schools immediately. In New York City, the majority of newly appointed teachers have no choice. Therefore, what can be offered as concrete, realistic help?

A fifth year for the fledgling. A year to become a strong, confident teacher. A year in which to build a materials file, unit plans, diagnostic devices, and lesson plans. A year in which being "alone" in the classroom is nonexistent. A year with skilled help and guidance as well as critical analysis of the work accomplished. A year to sit down and talk about difficult teaching problems with experts in the field. A year to think, and create. Time to meet the curriculum needs of the pupil by preparing new materials to be used in teaching. A year to understand the children in the classroom as individuals and try to meet some individual needs. No preservice training in the college classroom can ever hope to provide the laboratory atmosphere BRIDGE created.

ORGANIZATIONAL CHANGE FOR TEACHING THE DISADVANTAGED

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Can we show conclusively that the changes we propose for the improvement of education are sound? What are the processes by which proposed changes are brought about? When eventually the day of reckoning arrives, and we educators are asked for the evidence, what will we be able to say? In this sense then, the education of the disadvantaged cannot occur apart from the organization of the school of which he is a member. Effective teaching is not enough to solve the educational problems of the disadvantaged. All the concern shown by many segments of our society for the problems of the disadvantaged is not enough. The crucial factor appears to be the framework within which the effective teaching takes place. As long as we believe that somehow we must find a way to convince the disadvantaged child that school goals, as they exist, are worthy of his respect, and that somehow the school establishment as it exists will solve the problems of the disadvantaged, we appear to be doomed to disappointed failure.

We must also, I believe, keep in our minds the distinctions between the meanings of "disadvantaged", "culturally deprived", and "mathematically disadvantaged". And I believe that in place of mathematically, we might insert any subject name. I do not believe that difficulties in a subject are the peculiar property of mathematics. What is true is that deficiencies in this subject are rather obviously easy to measure. Whereas the use of other evaluative

criteria in other subject areas may result in the unintentional concealment of similar deficiencies.

I do not believe that the solution of the problems of one of the above groups necessarily implies the solution of the problems of the other two groups. For example, we may have a mathematically disadvantaged student in a calculus class if the teacher of that class does not perceive his role as the originator of creative teaching techniques which will, at an advanced level, help to keep that student reaching and growing towards intellectual and mathematical maturity.

Similarly I believe that we make a serious error if we attempt to categorize the disadvantaged as being the unique possessors of a lack of everything from verbal stimulation to cognitive skill. My experience with these groups in no way justifies any such all inclusive descriptive conclusions.

The evidence clearly demonstrates that any attempt to solve the problems of the disadvantaged which does not frankly face the fact that the problems of the colored disadvantaged child are magnified many times over the corresponding problems of his white colleagues will be largely ineffective. A recent statement by Mr. Whitney Young, head of the Urban League, replying to the question: "Do you think that Negroes are attempting to move ahead too fast in attaining social justice?", stated, "No, and for the following reasons:

1. Other ethnic groups such as the Irish, the Italian and the Jew were eventually assimilated and accepted by the white community. The Negro, however, being colored, could

not lose himself in a white neighborhood.

2. Unlike the white groups, the Negro not so many years ago had the basic structure of his family life and genealogical history destroyed by slavery. This had happened to no other group."

According to Mr. Young, any educational program which fails to take into account the deep-seated hurt and mistrust of the Negro disadvantaged, will be fighting an uphill battle. I do not believe that the solution of the problems of the white disadvantaged and the Negro disadvantaged necessarily proceed from the same premise.

As recently stated in a paper by Professor Nicholas Troisi, Professor of Continuing Education at Plattsburgh College, "Although the deprivations (of the disadvantaged) are generally recognized by teachers and school people, little has been done to accomodate school experience to the needs of the disadvantaged."

The secret of success, in my opinion, in work with the disadvantaged, is the extent to which the school community is willing to change its fundamental methods of operation, and indeed its basic structure, to really release the teacher's creative power. To digress for a moment, we have in New York State an Education law which clearly states what must be done to educate the mentally deficient. It spells out the kind and quality of school and teacher which is acceptable for such instruction. In no sense am I equating the disadvantaged with the mentally deficient, but I believe that we have the precedent for establishing laws that will make possible the legal foundation for similar requirements for the disadvantaged

In his recent book, "Helping the Disadvantaged Pupil to Learn More Easily," Dr. Frank Riessman, presently with N.Y.U. and formerly at the Albert Einstein College of Medicine, writes: "Too often administrators and teachers overlook the creativity of many disadvantaged children. A great deal of talent exists in the low income groups, not only because there are many poor people, but also because they possess learning styles that represent a unique untapped source of creativity."

In the paper by Dr. Troisi referred to above, he states "The disadvantaged acquire a cognitive style that in many ways is incompatible with the ways and styles of learning required by the schools." The crucial point that must be recognized by all of us is that the schools too must change.

I believe that we must begin with the teacher as the one most directly concerned with the education of the disadvantaged. The teacher must be sympathetic to the disadvantaged in a very special way. He must genuinely believe that the children are capable of learning. He must see that children perform best when helped to high but realistic expected standards of performance. In some respects the disadvantaged child is like an individual who has become run down or ill. The doctor may find it necessary to build up his patient before he can return him to the normal regimen and activities of the healthy individual. In a recent title one project affecting seventh and eighth grade children who are working below their ability levels we found one child who was reading at grade three level. With the patient, individual help of his English teacher, in three months he was able to read at the eighth grade level and is

still progressing. This same English teacher is teaching him to type by the touch system and he is showing the same phenomenal rate of growth. When working with the disadvantaged, we must establish rapport with these children by believing in them as human beings and in their potential as students. We have found in our experimental work, that it may take a year or more to become sufficiently well acquainted with them to get them to accept us as people who are able to help them and by whom they want to be helped. This means encouraging verbal exchange with the students. It means listening to them when they speak. It means giving them much opportunity for self expression. For role-playing, for making opportunities for their participation in school and class activities, and most important, for giving them an opportunity to improve their self-image.

Referring again to the little seventh grader mentioned above, I was observing his teacher working with him. At one point the discussion centered on what made a book precious or valuable. The author of the text had attempted to show that a book written by hand would be more valuable than one printed on the production line. But this boy did not agree. He stated: "What makes a book valuable is the truths it contains." (What more needs to be said?)

This kind of interest in children cannot be pretended. It must be genuine and the teacher must genuinely believe in it. If this does not happen the child will sense it instantly and much is lost.

Hidden beliefs on the part of the teacher that the colored child is not as good as the white child, or that the disadvantaged child will never learn anyway, and so why is he, the teacher, asked

to teach such dummies, will effectively prevent any educational progress not only for these children, but will carry over into other classes where the teacher thinks he is doing an outstanding job. The teacher then must honestly face his true attitude toward disadvantaged children.

Obviously the teacher must know the subject that he professes to teach. Deeply and with great comprehension, there is no substitute for knowledge of one's subject if one is to recognize the actual state of a child's knowledge. But also there is no substitute for the belief on the part of the teacher that the child is capable of excelling in whatever tasks he is set.

As rapport is established with the child, it will be the teacher who knows the subject thoroughly that will hear what the child with an inadequate vocabulary is trying to say when he attempts to express his ideas. This is true in any subject but is especially true in mathematics where specific meanings must be clearly discerned if the child is to make progress.

I believe that the content of mathematics is the same for all children, advantaged or disadvantaged. It moves faster for some than for others. Depth of consideration varies more for some than for others. Interest, as with any thing else is greater with some than with others. But skill formation, drill, reading ability, discovery, reasoning from abstraction, are equally valid and necessary for all.

It is the attitude of the teacher that really makes the difference. Change the attitude and everything changes. We can hardly expect the child to show the maturity necessary to change to an adult

way of thinking if the supposedly mature adult teachers are unwilling or unable to make changes in their outlook to effectively include the disadvantaged as worthy of their attention.

The teacher then must be willing to take a good look at himself and one way this can be done is through the use of Affective Variables. In a July 1967 paper of the University of Colorado Affective Behavioral Project of the Rocky Mountain Educational Laboratory the point is made, "The way students react to us is due in part to the way in which they perceive us. It is an interesting exercise to consider the number of emotionally toned words students might use to describe the teacher, themselves, or the lesson. In considering these descriptive terms think about how well you are able to create such perceptions."

accepting	enthusiastic	methodical	serious
active	exciting	open-minded	sincere
approachable	favorable	optimistic	sociable
arousing	flexible	outgoing	sophisticated
businesslike	formal	patient	spirited
calm	friendly	permissive	spontaneous
casual	funny	pleasant	stimulating
certain-sure	happy	provocative	stirring
challenging	helpful	quiet	successful
cheerful	imaginative	relaxed	supportive
competent	inspiring	reserved	sympathetic
concerned	interesting	responsive	systematic
confident	kind	rewarding	tactful
eager	likable	rigorous	thorough
encouraging	lively	secure	understanding
entertaining	masterful	sensitive	warm

The second condition that our experimentation has shown to be of importance, once the sincere teacher who really likes children has been found, is the involvement of all teachers concerned with the education of the child. These teachers must meet on a regular basis and discuss common approaches and carry over from one class

to another. What happens to a child in one class is of extreme importance and has relation to what happens to him in other classes. This is especially true of the disadvantaged. Each child must find his education meaningful. He must see a connection between what he learns in the English class and what he learns in the social studies class. and what he sees operating outside school. He must realize that the mathematics he uses in the mathematics class is the same mathematics that is used in the science class and in his world of experience. It is important that the actual structure of the school be changed from an administrative point of view, to make it possible for teachers to meet together regularly in a productive and mutually satisfactory way.

A third requirement for teaching the disadvantaged is the involvement of the parents. It has been suggested that parents do not know how to help their children effectively. If this is so, then it would seem essential that the education of the child and parent proceed somewhat apace. This can be done by home visits by the teacher and school community liason aids, and by inviting the parents to visit the classroom to see their children in action. Such visits have been found to be most effective and helpful. It takes time, however, and the time factor on the part of the school must not be permitted to be the stumbling block.

A reorganization of the administrative structure may well be in order, since there is no evidence that a given subject must be taken and passed in one year, or that every subject must meet a certain number of minutes every day, or that teachers must have a certain prescribed number of teaching assignments. When remedying

the difficulties faced by children from disadvantaged backgrounds, the time required to successfully teach may extend beyond any existing pattern. Relations between teachers and students may occur in completely new and different ways. I believe that in the last analysis the willingness of the schools to change so as to meet the needs of the disadvantaged may well be the salvation of the entire educational structure of the country, for when a child with a sympathetic teacher really begins to make progress, there is no stopping him. But this means that the next year's school pattern must be organized in a way that makes continued progress possible. The child cannot be forced into a mold for which he is not prepared, nor for which, because he is already more advanced, there is no acceptable course for him. New courses and new structures must be created to meet his needs. Disadvantaged children <u>can</u> learn if changes are made in the administrative structure of the school, in the curriculum, in ways of teaching, and the beneficial effects will be felt throughout the school program.

We must re-examine our school goals, to see to it that they are worthy of the earnest consideration of the students. Trying to make children conform to school patterns created for different socioethnic groups is not going to create the self motivational attitude on the part of the child so necessary for his success. We must be certain that the human yearnings of the disadvantaged are met. We must be certain that the colored child who is crying out for recognition of his worth as a human being, and his potential as capable of development, finds in the teacher a kindred spirit with whom he can establish rapport.

I am convinced that no filmstrip, no program, no curriculum, no teaching aid, can ever take the place of the sympathetic, skillful creative teacher who considers the students as fellow human beings who have personalities, hopes, and desires and are desperately striving for fulfillment. Auxiliary devices are of use only to the extent that the teacher knows how to use them, and makes them serve their intended purpose.

I am reminded of one of the little seventh graders in one of our experimental groups who said to one of his teachers: "I like school." His teacher, knowing his record of truancy in the years past, and who was suspicious of his statement, replied: "Oh, you can't fool me; you do not really like school. You are just saying that." And the child, with whom the teacher had established great rapport, replied: "No, I really mean it. I do like school this year. When I come to school now, I know that if one of my teachers gets mad at me there are four others who still like me, and with whom I can talk."

It is a very moving thing to behold what can happen between a disadvantaged child and the right teacher. It seems to me that administrative forces must place the search for such sympathetic teachers high on their priority list... As soon as the teaching profession becomes convinced of the worth of the human element in dealing with these youngsters we will see an increase in the number and quality of sympathetic, exciting teachers.

The willingness of the child to become a partner in the learning process with the adult depends essentially on the quality of the adult, and the willingness of the adult to accept the child on his

own terms with belief in the fact that the child is worthy of respect as a fellow human.

Successful results will be attained to the degree that administrative forces are willing to change the structure of the school itself to accomodate to the needs of the disadvantaged, and the extent to which the teacher holds the child to high levels of expectation.

So returning to the questions of the introduction:

Can we show the changes we propose to be sound? The answer is an unqualified "Yes" when results are measured in terms of the individual progress of the disadvantaged. Change in school structure, together with change in teacher attitude, are the absolute essentials in dealing with disadvantaged children. What are the processes by which changes are brought about? There is no one answer to this, but among those techniques which have been found to work, are mutual involvement of teachers, administrators, and parents. Our findings show that the most effective kind of involvement is opportunity for much discussion about the specifics of change.

As to the answer to the final question: What will we educators be able to say when the day of reckoning arrives and we are asked for the evidence? Only the future will tell. But we have an opportunity now to effectively educate all of our children. We dare not muff the chance.

THE USE OF TESTS IN PROGRAMS OF MATHEMATICS FOR THE EDUCATIONALLY DISADVANTAGED

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Last year the Bureau of Mathematics Education prepared some guidelines for developing comprehensive mathematics projects for the educationally disadvantaged under Title I. I would like to use this publication as a point of departure for my presentation this morning.

These guidelines indicate that pupil evaluation plays an important part in any Title I project in mathematics. It further identifies three different phases of evaluation, or three different testing activities, that should take place in a Title I mathematics project. The first of these is the identification of the mathematically disadvantaged. The second is the diagnosis of the individual pupil's difficulties in mathematics. The third is the measurement of achievement during the project year. I would like to discuss each of these in turn.

The problem of identifying educationally disadvantaged pupils is treated quite fully in a publication which was prepared by Dr. Ratchick's (Coordinator of Title I, ESEA) office in October 1965. Included in this publication are both qualitative and quantitative criteria, but my main concern here is with the quantitative criteria, particularly those that involve test scores. This publication indicates that the "primary criterion in considering educational disadvantagement is the reading level. Since reading is basic to school progress, a pupil markedly below reading level for his grade can be

considered educationally disadvantaged." The publication then goes on to describe what is meant by "markedly below reading level."

1. In the primary grades (1-3), reading below grade level.
2. In the intermediate grades (4-6), reading below grade level by two years or more, or achieving test scores below the 30th percentile according to State or national norms.

This publication also indicates that a pupil can be considered educationally disadvantaged if there is a marked discrepancy between achievement and capacity, that is, if the pupil is underachieving.

These same indicators have been adopted for identifying pupils that are mathematically disadvantaged, applying them, of course, to arithmetic tests rather than reading tests.

I am sure that the publication, Identification of the Educationally Disadvantaged, has proven to be extremely useful. It was first distributed at the very beginning of the Elementary and Secondary Education Act, and I know that many districts were grateful to receive this kind of guidance. But it may be time to take a closer look at the section that deals with the quantitative criteria of educational disadvantagement.

I think that the first thing that should be noted, in connection with testing in the intermediate grades, is that there is a considerable difference between being below grade level by two years and being below the 30th percentile in both reading and arithmetic.

In their Title I guidelines, the Bureau of Mathematics Education indicates that there are three commonly used achievement tests: The Iowa Tests of Basic Skills, The Metropolitan Achievement Tests and the Stanford Achievement Tests. The norms for these tests all show

the same thing -- that there are only about 5 percent of the pupils, nationwide, that are achieving two years below grade level in the sixth grade. Conversely, 30 percent of the pupils are achieving at least six months below grade level. It would be more accurate to equate two years below grade level with the 5th percentile and six months below grade level with the 30th percentile.

As you proceed down the grades from the sixth grade, you find a diminishing percentage of pupils achieving two years below grade level. In the third grade, it is less than 1 percent. The 30th percentile corresponds to less than six months below grade level.

In addition to this difference between the percentile and grade level criterion listed, there is also a problem concerning the norms that are used. As I indicated, the criterion is below the 30th percentile on either "State or national norms." Unfortunately we are lacking good information comparing achievement nationwide and achievement in New York State. There is some evidence, however, that achievement in New York State is superior to achievement in the nation as a whole. If this is true, then fewer than 30 percent of the pupils in a typical New York State school district will appear to be disadvantaged when national norms are used.

There is a third problem in connection with the criterion of disadvantagement referred to as "underachievement," or a disparity between the pupil's ability and his achievement. If the measure of ability is one of the commonly used intelligence or scholastic ability tests, many of the same factors are being measured as are measured by achievement tests in reading and arithmetic. It would seem likely, then, that it would be difficult to find disadvantaged

youngsters who obtain high scores on a scholastic ability test and low scores on achievement tests. This approach to identification may not be too useful at any grade level.

I raise these problems for two reasons: First, I want to suggest that you do not adhere too rigidly to the criteria published. There is room for subjective judgment when it comes to identifying the disadvantaged. Secondly, I want to introduce the idea that the establishment of quantitative criteria for identifying the disadvantaged is not a simple task. We know this because we have wrestled with the problem in connection with our own New York State tests.

The major problem in establishing quantitative criteria of disadvantagement centers around the absolute standard as opposed to the relative standard. It seems desirable to have some absolute standard of minimum competence or of disadvantagement. All of the criteria listed that deal with test scores are relative. They are based upon comparisons between the achievement of an individual pupil and achievement of other pupils, or the relative position of a pupil in a group of pupils. Even the grade equivalent or grade score of a pupil is relative. A grade score of 5.0 merely reflects the fact that this is the average score obtained by beginning fifth grade pupils on this test.

Perhaps the New York State Physical Fitness Screening Test comes closer to having an absolute level of minimum competence than any other standardized test. The Physical Fitness Screening Test consists of four different exercises. The Bureau of Physical Education took this test to approximately 90 physical education teachers around the State and asked them how many pushups or how many situp

a pupil should be able to do at each grade level if he is not to be considered physically underdeveloped. There was considerable uniformity among the various standards suggested by these teachers. Then the test was standardized, and the minimum competence levels were converted to a given percentile. The important point here is that the information concerning the achievement of pupils statewide was not available to the teachers at the time that they made their decisions about minimum competence levels.

Admittedly it is easier to do this kind of thing with a performance test than it is with a psychological test, but the Department is now in the process of organizing a similar study in connection with minimum competence levels for reading and arithmetic. Of necessity, it will be more complex than the study made by the Bureau of Physical Education, but it will have the same goal: to establish an absolute level of minimum competence.

At the present time, we are using an arbitrary minimum competence level which is the 23rd percentile as obtained in the fall 1966 Pupil Evaluation Program testing. This minimum competence level will remain the same for the next several years, so that school districts will be able to tell what progress has been made in reducing the number of disadvantaged pupils. Theoretically, it is possible that there will be no pupils below this point within a few years. This point in the distribution, the 23rd percentile, was selected primarily for administrative reasons. It is high enough to include those pupils with significant educational needs and low enough to insure an opportunity to provide for corrective measures. It was also selected because it is the point which

separates the third and fourth stanines, or achievement levels as they are referred to in connection with New York State tests. With stanines, or achievement levels, the distribution of pupils' scores is divided into nine equal units. They are equal in the sense that the difference between level four and level five is the same as the difference between level eight and level nine. Percentiles are not equally spaced units. There is a much greater difference between the 98th and 99th percentiles than there is between the 50th and 51st. At any rate, if a pupil obtains a score at level three or below he can be considered educationally disadvantaged.

Schools that have Title I projects involving pupils in grades 1, 3, 6,or 9 can use the criterion of disadvantagement established by the New York State tests. At other grade levels it will be necessary to use commercial tests and to establish comparable cut-off scores. As I previously indicated, at the present time there is room for judgment in the light of the particular characteristics and needs of the school district.

Perhaps I should mention here our plans for revision of the New York State tests in arithmetic. Last spring we pretested a large number of questions which will be used to revise the junior high school test in mathematics. The revised tests will cover material contained in the latest syllabus for grades 7 and 8. There is a possibility that this revised test will be included in next year's Pupil Evaluation Program at the beginning of grade 9 in place of the present minimum competence test in arithmetic fundamentals. If this is done, the tests for grades 3, 6, and 9 would be comparable in the sense that they would all measure a wide range of achievement and

would thus probably produce more useful results in the ninth grade.

Similarly, questions were pretested this fall for revisions of the test for third and sixth grade arithmetic. Probably in the fall of 1969 these tests will replace the present tests in the Pupil Evaluation Program. Studies will be made to insure comparability of test results when these changes are made.

I want to turn now to the use of tests in diagnosing pupil difficulties or in the determination of individual pupil needs. Everyone here is aware of the fact that there are few, if any, really satisfactory diagnostic arithmetic tests available. In fact there are only about nine or ten tests that come close to being diagnostic tests, and most of these are seriously out of date. In contrast, there are more than 25 diagnostic tests in reading and most of them are revised regularly. Apparently the commercial test publishers don't feel that there is a market for diagnostic arithmetic tests and there may be a good reason for this. Almost any arithmetic test can be used for diagnostic purposes. It is only necessary to regroup the questions or to rescore the test to provide more meaningful subscores. Some of the achievement test manuals contain instructions which will enable the teachers to do this restructuring.

The authors of the Stanford Diagnostic Arithmetic Test indicate that there are two main differences between a diagnostic test and an achievement test.

> First, an achievement test attempts to cover a broader range of areas within a given period of testing time than does a diagnostic test. The diagnostic-type

> test, on the other hand, provides more detailed measurement within a specific area, thus emphasizing the identification of strengths and weaknesses within this area...A second important difference between these two types of tests relates to their difficulty level. In general, subtests within an achievement test are designed to have an average item difficulty in the 45-65 percent range with about as many very difficult items as very easy items; and, an achievement test attempts to cover, insofar as possible, the entire range of ability or performance for specified grades or age groups. A diagnostic test, however, should have a larger per cent of easy material since it is developed primarily to assess below average performance.

There are other differences, having to do with reliability and intercorrelations among subscores, but they are of secondary importance.

These differences suggest that one solution is to use, as a diagnostic test, an achievement test which is aimed at a lower grade level, and perhaps to use more than one test in order to get a sufficient number of questions centered around a particular operation or concept. It may also be desirable to develop diagnostic tests locally; this is a fairly common practice in the field of reading.

We are talking here about group testing. As indicated in the guidelines from the Bureau of Mathematics Education, it is often more productive to administer diagnostic tests on an individual basis. The teacher can learn a great deal about the pupil's needs if the pupil works through problems with the teacher. When this is

done, almost any test or group of questions may be used.

This may be a good point at which to talk about test validity. Validity deals with the degree to which a test is capable of achieving certain aims. Too often tests are selected for use without regard to their validity. In order to select a valid test, the user must keep in mind the purpose for which the test is being used. If he is interested in predicting success in a course of study, he must select a test that measures the outcomes of that course of study. If he is interested in predicting success in a course of study or in an occupation, then he must select a test that has demonstrated value in predicting success. If he is interested in diagnosing strengths and weaknesses, he must select a test that produces subscores that are meaningful and useful in planning corrective measures. This means that the test must be examined in considerable detail -- not just the manual, but the questions themselves. There can be no justification for using a test that does not meet the needs of the user.

The final use of tests is in what is referred to as the "determination of the student's level of achievement." The guidelines put out by the Bureau of Mathematics Education say this:

> In a Title I project, interest is focused upon the difference between achievement levels of the student at the beginning of the project year, and at the end of the project year. A significant difference between pretest and posttest scores for most students tends to indicate a successful project.

There are really two different concerns here. The first concern is with the progress made by individual pupils. In the course of the project, the teachers will want to administer their own tests and make other informal estimates of the progress that pupils are making in order to guide them in the development and use of learning activities. At the end of the project year, the teachers will want to administer a standardized test in order to measure the overall change in each pupil's level of achievement. Hopefully the test administered at this time will be an alternate form of one of the tests administered at the beginning of the project, either the test used for identification or the test used for diagnosis. This will greatly simplify the job of evaluating pupil growth and progress.

The problem that arises at this point is to determine whether or not the changes that have taken place are significant changes. The use of a control group which is comparable to the experimental group, although desirable, is often impractical. Thus it must be necessary for most schools to merely establish some arbitrary degree of improvement which is considered to be significant. It is interesting to note in this connection that the standard error of measurement for most arithmetic achievement tests, in terms of a grade score is approximately 4-6 months. If a test has a standard error of measurement of six months, this means that there are two chances out of three that the score obtained by a pupil is within six months of his true score. The chances are one out of three that the score obtained by a pupil differs from his true score by more than six months. This kind of information, which is reported in every test manual, should certainly be taken into account when evaluating the

significance of differences observed at the beginning and end of a Title I project.

The first concern, then, is with the progress of individual pupils. The second concern is with the effectiveness of the project. This is what the Deputy Commissioner of Education refers to as "accountability." In a speech made last April, he said:

> The Educational community is being called upon to provide increased accountability to its many constituencies for the financial support received.

In a speech made in September, this idea of accountability was discussed in considerable detail. He indicated that:

> There are two aspects to accountability in education:
> 1. Have the funds been spent for the puposes intended, and
> 2. what effective use has been made of them? These are the two fiscal and educational aspects. No one can protest that one should be held fiscally accountable for money received and spent. But educators, because they deal with a largely intangible product, are not quite as used to as others are, to providing a full reckoning for funds received. Education is too often thought of as in a class with the American flag, baseball, and motherhood -- they have a sanctity which should go unexamined.

Certainly one aspect of accountability is the significance of the improvement which has taken place in the pupils, but it is not the only aspect of accountability. There are other questions which should be raised in evaluating the effectiveness of a Title I project.

1. Were there any undesirable outcomes of this project?

2. Could there or should there have been a greater improvement in pupil achievement?

3. Could this improvement have been made more efficiently or economically by some other means?

This is by no means a complete list of the questions that should be raised at the conclusion of a Title I project. It is only intended to suggest what is meant by accountability.

Thus, there is a dual challenge to everyone in the educational community at both the state and local level. First, there is the challenge of helping disadvantaged children to find equality of educational opportunity. The second challenge is in doing this job with a sense of stewardship for the financial support received.

RESEARCH STUDIES

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The Elementary and Secondary Education Act of 1965 defines the "educationally deprived child" as one whose educational achievement is below normal expectancy for his age and grade and who lives in poor social and economic conditions. The term also includes those children who are handicapped because of physical, mental, or emotional impairment. ESEA also recognizes that "environmental conditions and inadequate educational programs rather than lack of mental aptitude carry the major responsibility for the later failure of these children to perform adequately in the school system."

We know, then, who these children are and we know that they are found mostly in the slums of cities, certain rural areas, migrant labor camps, and Indian reservations; and we know that the consequences of such environments are the school dropout, delinquency, mental retardation, and educational retardation.

It is within this framework and with these basic assumptions that most of the sparse existing research has been conducted. The types of research generally fall into four categories:

1. the effect of the environment on mathematical learning, especially in the kindergarten and primary grades
2. curriculum experimentation at every grade level
3. methodology
4. the effect of remediation programs

I shall discuss experimental programs, research projects, and since it is impossible to discuss research studies without also discussing things such as goals, outcomes, and the like, I shall mention these things also. How many research studies exist and how good they are, is still a matter for conjecture.

In order to evaluate the research studies I have found and to determine if they are really providing us with the answer we seek, it would be well to examine, first of all, some of the statistics. For from the data it becomes shockingly clear to me that the longer these so-called disadvantaged children remain in school, the greater the decline in their academic achievement. For example, consider the data drawn from standard tests administered in the third, sixth, and eighth grades throughout the New York City school system. These tests include sixth grade arithmetic (Metropolitan Intermediate A) and eighth grade arithmetic (New York City Computation). The results for the Harlem children is as follows: -- for the sixth grade, 57.6 percent are below grade level in computation, 66.6 percent are below in problems and concepts, and for the eighth grade, 83.8 percent are below. Most distressing is the fact that these children are below the achievement levels of both the city and the nation. In the third grade they are one year behind New York City, by the sixth grade they are nearly two years behind, and by the eighth grade, they are two and a half years behind New York City and three years behind the nation. And most of us were appalled when we read the New York Times article of Monday, January 16, 1967, which stated that last year in most grades 60 percent and sometimes more, of the city's pupils were below the national norms. The grade-by-grade

gaps between city achievement levels and the national norms were even greater in arithmetic than in reading.

Abundant literature on the education of disadvantaged youth exists; but such literature revolves around the processes of change in the children, themselves, in their schools, and in the larger society. Most of all it concentrates on their special cognitive learning problems and their special problems of emotional-personality development. The amount of literature aimed at improving the education of these children most assuredly is increasing; but the bulk of it is descriptive and speculative; it includes very little research.

There are not very many systematic studies which one would categorize as "research" in any subject matter area in the field of learning, and least of all, in the field of mathematics. Any systematic studies which exist consist mainly of evaluations of early childhood enrichment programs and dropout-prevention programs, analyses of the treatment of minority people in textbooks, studies of the effectiveness of specified teaching procedures and counseling programs, studies of teachers' attitudes and perceptions, studies of the classroom activities of teachers who are "effective" with lower class pupils, evaluations of a significant demonstration project, and studies of segregation-integration as a variable of scholastic achievement. There is no doubt, then, that the need for research exists. Let's see what actually is being done in mathematics.

On the basis of one of the recommendations made at the SMSG conference in April 1964, SMSG is attempting to gather information helpful in the development of a mathematics program for disadvantaged

children in the elementary grades. Experienced teachers in six major cities are using SMSG kindergarten and first grade books with children from deprived areas. Additional classroom materials as well as consultants are supplied by SMSG.

An inventory was constructed to determine the level of children's preschool experience in certain clearly defined areas. Two classes in a disadvantaged area where the schools are not receiving the additional materials and consultants mentioned above were selected. Classes in middle-class areas of two cities were used as controls. The inventory consisted of a series of tasks taking approximately 30 minutes. (Explicit directions were prepared and pre-tested on a group of five and six year olds in the Oakland, California area). Early in the school year assessments of the following dimensions were made:

1. Ability to recognize objects and pictorial representations of objects to be used in the curriculum materials
2. Ability to match two sets of color cards, to name a given set of colors, and to identify a color when it is indicated by name
3. Ability to recall an object after it has been removed from a given set
4. Abilities relating to number (five parts)
   a) ability to select a given number of buttons from a heap 3, 5, 4, 6, 8, 7, 9
   b) ability to mark number symbols 0, 1, 3, 4, 5, 7, 8, 9

c) ability to recognize number symbols

d) rote counting ability

e) concept of ordinal number

It was found that the achievement of pupils in the experimental classes was generally below that of the control classes on the tasks tested. These differences were greater in the first grade than in kindergarten. More specifically, the majority of pupils in the control classes could do all seven tasks of counting buttons correctly; only about half in the experimental classes could. In the first grade control classes, all the pupils could name each of the number symbols whereas many of the first grade experimental classes were unable to name all of the symbols and a significant number could not name any.

The results of the inventory show that many first grade children from deprived areas are below the mean achievement level for middle class kindergarten children, while others in the same classroom are achieving as well as middle class first graders. It is the opinion of SMSG that students from deprived backgrounds are not initially prepared to learn mathematics at the same pace as middle class children and many have not reached the same level of cognitive development.

Kenneth Easterday reported the following study in the Mathematics Teacher of November 1964. Its aim was to determine if "modern" mathematics could be taught effectively to low achievers. Also could the reasoning and/or fundamentals of low achievers in the junior high school be significantly increased? Thirty-seven eighth graders with median IQ of 100 and 41 seventh graders with

median IQ of 94.1, age 11-15, were used for the study. With overlapping considered, 25 of the eighth graders and 20 of the seventh graders had a history of academic difficulty, discipline problems, and/or psychological problems prior to entering the program. The California Achievement Test, Form X was given at the start of the school year.

"Traditional" mathematics was used to strengthen the fundamentals or computation; "modern" mathematics was used to strengthen both the reasoning and fundamentals. This material was adapted from the material prepared by the SMSG for the elementary school - EM 101 - 107. Concepts were introduced through techniques suggested by SMSG and additional practice was provided by "traditional" worksheets. Both grades started at upper fourth grade level. As individual children reached a level where they could not function, they were removed from the class and formed into small groups for added instruction. A test was given after each topic. If the child was successful he was moved on to the next step; if not, he repeated the process until the teacher felt that no positive results could be had with additional time. Levels of expectation were adjusted. If the child had difficulty reading, the material was read to him independently. The movement within groups in the classroom and entering or leaving the program was fluid. At the end of the school year the California Achievement Test Form W was administered.

It was found that there was growth in mathematics reasoning and fundamentals. The entire sample had a median composite increment of 1.25 years and there were individual increases of up to three or four years.

What effect do differences in socioeconomic background have on kindergarteners' arithmetic concepts? To answer this question, four kindergarten classes of 82 pupils, 51 from a low socioeconomic section and 31 from a high socioeconomic section in the San Francisco Bay area were chosen. The children were given the Arithmetic Concepts Inventory for Kindergaretn and Entering First Grade which consists of five sections - enumeration, quantitative relationships, symbol recognition, social usage, and problem solving. No IQ tests were given because it was felt that no test existed which could possibly give an accurate measurement for these children. The results indicated a significant difference in the mean scores. For the low socioeconomic it was 15.35 and for the high socioeconomic it was 24.16.

Another study in this category posed the complex problem: To ascertain the nature and extent of achievement of pupils who are entering kindergarten with respect to selected mathematical concepts, skills, and abilities as described by test items requiring mathematical insights and/or skills and abilities; to discover the levels of achievement of various groups when categorized by selected psychological and sociological factors; to ascertain by the correlation method the extent of relationship that exists between the test of mathematical achievement and various psychological and sociological factors; to discover some of the circumstances and conditions existing in the home which apparently influence some kindergarten entrants to attain a high level of mathematical achievement while others of equal mental ability fail to realize proportionate accomplishment. Five hundred and ninety-five kindergarten

entrants from six elementary school districts in southern California located in the greater metropolitan area of the city of Los Angeles were chosen. The various tests were administered to children present in 16 classrooms, to every third child present in nine classrooms and on a random basis to children in seven classes. The mean IQ for the 301 boys was 101.45 and for the 294 girls 106.02, for the group 103.71. It was found that there is a definite but small relationship between socioeconomic status and mathematical achievement. The extent and nature of mathematical achievement of kindergarten entrants are far-ranging and are associated with a number of factors.

The relationship between IQ and problem solving is very much lower than the relationship between IQ and concepts learned. When the IQ level is taken into account at various IQ levels, the percentage of pupils from each socioeconomic group classed as high, average, or low achievers is the same. These are the findings of Leland H. Erickson ("Certain Ability Factors and Their Effect on Arithmetic Achievement") who worked with 269 sixth grade pupils in eight classrooms in four public elementary schools in a midwestern city school system. Two of the schools were of a high socioeconomic culture and the other two were of low socioeconomic culture. The tests used were: Iowa Tests of Basic Skills, Form 2,1956, Otis Quick Scoring Mental Ability Test, and Iowa Silent Reading Test.

The following two studies are important, I believe, because they attempt to show what can be done for the educationally disadvantaged child.

The Youth Development Center at Syracuse University in collaboration with the Arithmetic Studies Center at the University conducted a survey of the extent of underachievement in arithmetic at the eighth grade level in a junior high school situated in a depressed area of an eastern city. (The student body of the school is drawn from the lower socioeconomic section of the city and over 70 percent of the population within the age range, 0 to 19, is nonwhite).

The eighth grade population of the school was divided into four IQ subgroups within the range of IQ scores. The mean IQ for the entire group was 90. Children above the mean IQ of the group were generally under-achieving while those below the mean were generally over-achieving. The under-achievement was greatest in the upper extremes of the IQ range. The top 15 percent of the eighth grade group average 20 months under-achievement with some children under-achieving by as much as 55 months. On the achievement test norms, these brighter children were generally achieving below the 30th percentile. Hence, the experimental program was conducted at the school for the following purposes:

1. to try to get a more detailed picture of the nature of the under-achievement in arithmetic at an eighth grade level in a school situated in a deprived area
2. to ascertain if individual diagnostic and remedial treatment procedures being used at the Arithmetic Studies Center could reduce significantly the amount of under-achievement

of an experimental group as measured by a standardized achievement test.

Twenty pupils with high discrepancy between their mental age and their arithmetic-achievement age were chosen from the eighth grade population of this school. They were given the California Arithmetic Test, Form W, as a pretest. They were then divided into two groups of ten, each composed of six boys and four girls. One was classified as the experimental group, the other as the control group.

	Mean Age	Mean IQ	Mean months of underachievement
E	13.4	108	18
C	13.8	102	18

Each child in the E group was interviewed individually by the researcher. After initial interview and scrutiny of the California tests, some of the children seemed to indicate that they had common difficulties and were grouped together. The program proceeded with one group of three, two groups of two, and three people meeting individually. During the three-month duration of the program, there were generally eight to nine meetings of 45 minutes duration held with the experimental group.

Although various students required different types of help, much of the time was spent on base 10 notational system, part-whole idea of addition, and subtraction as the inverse of addition, factor-factor-product idea in multiplication, and division as the inverse of multiplication, and arithmetic terms. The final two or three meetings were spent on improving computational skills; Brueckner's "Diagnostic Tests and Self-Helps in Arithmetic" were

used for this purpose. No extra work was done with the control group during this period. Both groups proceeded with the usual textbook program taught by the regularly assigned teacher. The California Arithmetic Test, Form AA, was administered as a post-test to both groups.

The results show that the experimental group gained considerably more during the period than the control group. The underachievement in the experimental group was cut in half. The control group, on the other hand, was underachieving more at the end of the the three-month period. (E - 9 mo., C - 19 mo.) These results seem to indicate that these bright children can be beneficially affected by a good diagnostic and remedial program in mathematics.

Using another technique, a pilot study was made for the purpose of determining the relative effectiveness of the TMI Programmed Text, Multiplication and Division in remediation with selected fifth and sixth grade pupils. The 78 pupils used in the study were selected from a population of three fifth grade and three sixth grade classes in one of Albany's public schools located in a low socioeconomic census tract. They could do addition and subtraction but were inferior in multiplication and/or division computation ad determined by the Brueckner test. Two groups were formed at random; one group used the programmed text (experimental) and the other group used conventional workbooks (control). They spent 20 minutes each day working with these books during the time usually devoted to individual instruction. At the termination of the five months' experiment, both groups had gained significantly in ability to do multiplication and division, but no group was superior to the other.

Today, many people in the field of mathematics and mathematics education are interested in the education of the low achiever in mathematics. Although they are not actively involved in research, they are contributing their efforts toward making the learning situation better for these youngsters. To this end, many colleges and universities are participating in experimental programs. In all cases there is much good will, but in many instances there is evidence also of misdirection.

For example, there is a multiple project at N.Y.U. called Clinic for Learning. Experimental work is being done in various subject areas. For the mathematics program, N.Y.U. has taken over the entire seventh grade of a J.H.S. in the Bedford Stuyvesant area of Brooklyn. These classes are broken down into clusters of three classes. There is no coordination of the curriculum for the entire group and there is none for any cluster. Each teacher works autonomously. There are no controls and there is no plan for research. The coordinator of the program is using the Cuisinaire Rods with a 7-13 class. He hopes to bring them from a state where they didn't even know what minus means to a state where they will understand the concept of numbers and the relationships between numbers. He, by the way, is an English teacher but his 'main interest is in the thinking process!"

Some of these programs have suffered from teacher attrition, and also from the failure of the participants to carry out the programs as they were originally planned. A good example of this is the Dual Progress Plan.

The following episode has not been published by SMSG, but I understand (Begle reports) that they gave a seventh grade class the addition and multiplication table to use just as you would a dictionary. These pupils, of course, did not know how to multiply, add, divide, or subtract. Yet, at the end of the year, they had improved by two years. They used the regular SMSG materials and they learned the fundamental addition and multiplication facts better than if they had been told to learn them. The teacher in this instance is an exceptional teacher so that this may be <u>the</u> significant factor in this improvement. Hence, we have no conclusive evidence that this procedure will always work.

From the limited number of research studies mentioned here today, one must conclude that there are far more variables, other than environment, involved in low achievement. No generalizations about the ability of disadvantaged children can be made. However, there are materials which can be created for these students and there are methods of presentation which have proved successful. There <u>is</u> a new approach to teaching the low achiever in mathematics and "inherent in this new approach is the assumption that the low achiever is probably capable of doing better if only the causes of his poor performance can be identified and counteracted."

It would seem that individualized teaching is important. Groups are useful when the students have the same needs. One of the best treatises in this area is a book by Alfred Yates called <u>Grouping in Education</u>. What is noteworthy about this book is the consistency of the research findings about "self fulfilling prophecy", that is, expectations determine the outcome.